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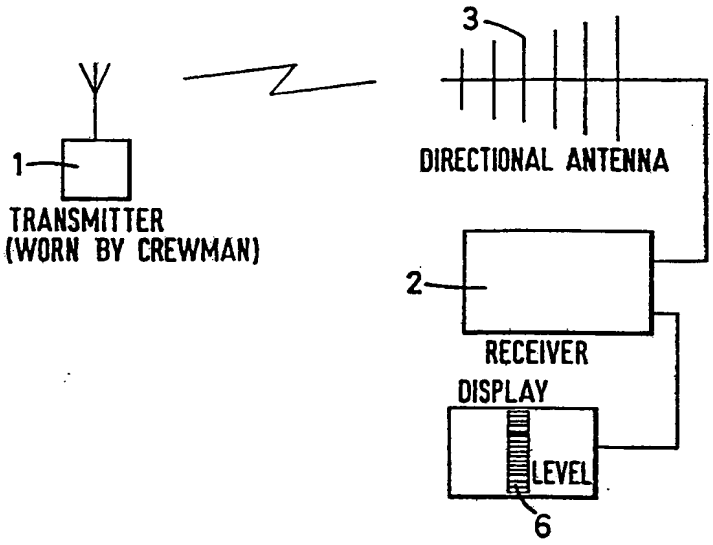
(54) Title: EMERGENCY RESCUE SYSTEM

(57) Abstract

The system is characterised by a personal transmitter (1) designed to be actuated in an emergency to emit a signal, an antenna (2A, 3) for receiving said signal, and a receiver (2) for receiving the signal from the antenna to activate an alarm, said receiver including a detector circuit (2B to 2K) which responds to variations in signal strength from the antenna for producing an audible (2Q) or visual (20) indication of said strength. Thus, when the receiver alarm is activated by said signal, the rescuer can assess the direction of the signal transmission by said variations in signal strength. In one arrangement, two antennae (9, 10) are provided for fixing to the masthead so that they are spaced apart to port and starboard, any signal received from a personal transmitter (1) being amplified by the receiver (2) to activate a boat alarm and thereby enable the helmsman to initiate man-overboard procedures. Thereafter, for locating the direction of the signal, said two fixed antennae (9, 10) are phased to provide left/right signal information for said receiver (2), which latter includes a display of the appropriate signal strength. In another arrangement, one fixed omni-directional antenna (2A) is provided for fixing to the masthead to pick up a signal from a personal transmitter (1) and operate a boat alarm. For locating the direction of the signal, a second, portable, directional antenna (3) is provided which is connected to said receiver (2) and, in use, is handheld and swept around the vessel to obtain a reading (6) of greatest signal strength. A test facility is built in to the system where at any time a transmitter and a receiver can be operated to test their function without causing alarms to other users.



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Emergency Rescue System

This invention relates to rescue systems for locating the position of persons in an emergency and has application, for example, at sea for locating and recovering a man overboard, or on land for locating and rescuing missing persons, eg by the mountain rescue services.

The object of the invention is to provide a rescue system which enables the direction of the missing person from the rescuer to be assessed.

According to this invention, such a rescue system comprises a personal transmitter adapted to be attached, or worn, by a person and which can be actuated in an emergency to emit a predetermined signal, an antenna for receiving said signal, and a receiver adapted to receive the signal from the antenna and to activate an alarm in response to said signal, said receiver including a detector circuit which responds to any variations in signal strength from the antenna for producing an audible or visual indication of said strength, the arrangement being such that when the receiver alarm is activated by said signal, the rescuer can assess the direction of the signal transmission by variations of intensity of signal strength derived from the detector circuit of the receiver.

It will be appreciated that, for marine applications, the system can be used widely, eg by pleasure sailors, racing yachtsmen, powerboat sailors,

children of almost any age, fishermen, lifeboatmen; in short anyone who spends time on vessels afloat. The system can also be used for persons working near or over sea or fresh water, eg oil platform or dock workers. Especially for sea applications, the personal transmitter can be provided with a battery which is activated directly, or via a switch, by contact with salt water, so that no action is required from the man-overboard.

Alternatively, to cater for vessels which sail in sea and fresh water, a switch may be provided can be operated by contact with fresh water.

The personal transmitter may be worn either on a life-jacket, or on the person via a wrist or neck strap, or harness, or some other item of clothing. Any location should be chosen to be the most easy to wear for the individual, thus encouraging wearing at all times.

It is intended that, on board a marine vessel, a personal transmitter be worn by all crew members so that if any crew member falls overboard his transmitter is activated by the salt or fresh water and automatically, with no involvement of the crew member, begins transmitting a signal, which can be an unmodulated carrier, or a coded and modulated tone or tone sequence.

In the case of a masted vessel, a masthead antenna array can be used to receive the signal, and any signal received would be amplified by the receiver to activate an audible alarm. The helmsman would then initiate man-overboard procedures in response to the alarm. Thereafter, the system would be used for location

of the man overboard. For this, in one arrangement, two fixed antennae in an array are provided, which are spaced apart to port and starboard, the antennae being phased to pick up the transmitted signal and provide left/right signal information for said receiver, which latter would include a display of the appropriate signal strength for the helmsman. Alternatively, an antenna which would be preferably omni-directional, could be provided to pick up the signal initially, and a portable, directional antenna provided which, in use, would be handheld and swept around the vessel to obtain a reading of greatest signal strength.

To smooth out sharp variations in signal strength during sweeping, eg due to wave movement between a vessel and a man-overboard, the receiver may incorporate a memory circuit which is operative to ignore said sharp variations.

The directional antenna may be in the form of a plate, eg of plastics, with sensing elements embedded therein in a directional array (eg a YAGI or logperiodic antenna), and supporting a display of signal strength, eg a bargraph comprising a line of light emitting diodes (l.e.d's). Alternatively, or additionally, an audible signal perhaps of a rising tone with increasing signal strength maybe used.

Conveniently, the plate can be mounted on a handle resembling a pistol grip to facilitate sweeping movement of the plate in a horizontal attitude in use. Also, when not in use, the plate can be stowed in a

holster which is mounted in a convenient position.

For land, and for windsurfer and dinghy applications where the sailor is normally wet, no salt water switch would be provided; instead, each personal transmitter would have a battery power pack and a panic button to enable the wearer to activate his transmitter manually.

The personal transmitters can all be on the same frequency, in which case, for marine applications, a man-overboard can be alarmed, and located, from any boat in the vicinity. The transmitter's signal can also be coded, so that each boat has a separate code identity. Also, the signal can be coded so that the casualty type is indicated, eg one type for windsurfers or dinghy sailors (who would need a panic button to operate their transmitter as they get wet normally), another type for cruising yachtsmen, another type for racing yachtsmen, etc.

In order that the invention may be readily understood, two embodiments of personal transmitters and one embodiment of a receiver and two different arrangements for the system particularly for marine applications, will now be described with reference to the accompanying drawings, in which:

Figure 1 is a block diagram of the personal transmitter,

Figure 2 is a block diagram of the receiver,

Figure 3 is a block diagram of a handheld, directional antennae receiver arrangement,

Figure 4 is a diagrammatic view of the directional antenna and a holster therefor, and

Figure 5 is a block diagram of a masthead antennae/receiver arrangement.

Referring to Figure 1 of the drawings, the personal transmitter 1 is preferably a crystal oscillator device 1A, the generated signal from which is modulated by a modulator 1B and multiplied in stages 1C and 1E, via a buffer 1D, up to the frequency required. Thereafter, the signal is fed by a power stage 1F via a low pass filter 1G to an antenna 1H. An alternative system is to use a synthesiser "multiplier" where a low frequency crystal around 12MHz is used within a "phase locked-loop" to stabilise the output from an oscillator running at the final frequency. This would be followed by a power stage as described above. It is anticipated that a small area of frequency spectrum will be used, perhaps between 800 MHz and 1000 MHz. The transmitter power output would be of the order of 50 - 400 milliWatt, although a lower power may be necessary to limit range on calm days. The difficulty is to ensure that a signal from the transmitter antenna, awash in a heavy sea, can be received while avoiding alarms being activated at considerable distances in calm weather. The line-of-sight range at present is estimated at about 1 kilometre, using about 50 mW transmitter output, and a receiver sensitivity of about 5 microVolt.

Referring to Figure 2, the receiver unit 2 includes a receiver antenna 2A, the signal from which is

fed in series through a bandpass filter 2B, an RF amplifier 2C, and a further bandpass filter 2D, and then mixed in a balanced mixer 2E with a local oscillator signal fed from crystal 2G via an analogue or synthesiser multipler 2F. The mixed signal is then fed via a crystal filter 2H, to provide a first IF signal, which is then fed to a single chip receiver 2I (to which a second local oscillator 2L is connected) to produce a received signal strength indicator output which can be fed via ceramic filters 2J and 2K to be rectified in a rectifier 2M, amplifed in an amplifier 2N and sent to a display 20 and possibly to a tone generator to produce an audible signal. If the signal is modulated, the modulation can be recovered, buffered in an audio buffer 2P and sent to a speaker and/or phones 2Q. An alternative type of receiver can be used which is basically a filtered RF amplifier.

Referring to Figures 3 and 4, the handheld directional antenna/receiver arrangement includes, in addition to the transmitter 1 and receiver 2, a portable, directional antenna 3, which is preferably formed as a flat plate 4 of approximately A4 page size, tapering slightly in a forward direction, and with a pistol grip 5 under. Such an antenna is a logperiodic or a YAGI array and is preferably moulded in plastics with bargraph elements 6 incorporated, thus avoiding contamination from the environment, and to make the unit safer for use in front of the face. An A4 page size antenna will be of about 10 dB gain, and will have about a 30 degree wide front lobe in the polar diagram at 800-1000 MHZ. The

stowed in a holster 7 on the vessel when not in use, which includes a connection for battery charging current or a ship supply. The holster would also either provide an RF connection to either the existing vessel VHF antenna downlead, or a fitted omni-directional antenna as described hereinbefore via a circulator/directional coupler, to provide omni-directional coverage for the alarm mode, or support the directional antenna so as to provide an essentially omni-directional antenna in a horizontal plane. With the receiver antenna 2A at masthead height, good coverage can be expected. While the directional antenna 3 is installed in the holster 7, a loud audio sounder is enabled, to alert the crew to a man-overboard. Removal of the antenna 3 from the holster can be made to quieten the alarm, and enables the bargraph display 6 on the antenna. The directional antenna 3 can also be designed with a detector circuit to produce a high pitched audio tone, when pointed directly at the man-overboard, and a large reading on the bargraph; and when pointed away, or at an angle to him, a lower tone, and smaller reading on the bargraph.

If desired, the receiver unit 2 can be encapsulated within or adjacent to the pistol grip 5, and can drive the audio and visual displays, powered either from a battery within, or by a coiled, extensible cable from the vessel, in which case, preferably, the complete antenna/receiver unit can be made waterproof and able to float. The pistol grip 5 can have a wrist loop, or lanyard 8, to ease handling in the worst environment

(moonless night, heavy sea running, etc).

Referring to Figure 5, in this arrangement the receiver unit 2 is mounted within the vessel, and connected to the masthead array antenna downlead, the displays, and on-board power. The difference to the handheld receiver is that the masthead has two spaced, port and starboard (left and right), antennae 9, 10 which are connected via a suitable coupler unit 11 to pick up a signal with a phase variation (when not dead ahead), and convert it into an amplitude variation, which is subsequently switched by a keyer 12 to send to a single input on the receiver. The signal strength output from the receiver is therefore compared with the keyer, which is alternately switching from left to right antennae, and the net signal used fed via a left/right driver 13 to a display 14 to show the man-overboard approximate position (left/right). The average signal is a function of the distance of the man-overboard, and can also be displayed.

In use of the marine rescue system described above, the sequence of operations are as follows:-

1. All crew affix their personal transmitters 1 before the vessel leaves her berth, or mooring and test them.

2. A crewman falls overboard.

3. The water-activated battery powers the transmitter 1 to produce a man-overboard signal.

4. The receiver antenna 2A, 9 or 10 detects the signal (preferably after a short delay to avoid nuisance alarms), and together with any other vessel so equipped in the same locality, an audible alarm in the receiver 2 is set off on

the vessel. This could be latched on, or not, as the signal strength will vary in a large sea.

5a. (Fixed shipborne system) The alarm is cancelled, and the helmsman (or any other so alerted) uses the display 14 of left/right information, and signal strength, to direct the vessel to the man-overboard.

5b. (Handheld directional antenna/receiver) A crewman on the vessel (or on any other vessel so alerted) removes the directional antenna 3 from the holster 7, which quietens the alarm, and enables the tone/bargraph 6 on the receiver handheld unit. When pointed at the horizon, and swept around the vessel in azimuth, a rise in tone and increased column on the bargraph should be experienced, which will peak when pointed toward the man-overboard. The crew can then turn the vessel to the required course, and by monitoring the peak signal can keep the vessel on track to the man-overboard. The effect of a large sea will be to interrupt the signal with waves between the man-overboard and the vessel which will make the location less easy, but this problem can perhaps be at least partly overcome by the inclusion of a memory circuit in the receiver unit 2 to clip out sharp variations as discussed hereinbefore.

6. The final recovery of the man-overboard is a difficult act of seamanship (not within the scope of the present invention), but by bringing the vessel and the person to the same locality the most critical phase is completed. The transmitter 1 will cease when the battery is taken from the water.

7. A test function is available to all users in that a

switch on each transmitter will operate the transmitter for a short time. The receiver will not normally respond to a short transmission, as to avoid nuisance alarms it requires a longer (a few seconds) signal. The receiver also has a switch which will inhibit the above time gating. Thus when a transmitter switch is actuated and the receiver is in test mode, either the alarm will sound (receiver in holster) or the display/audio output will be produced (receiver out of holster). This test function allows testing of almost all the aspects of the system and encourages improved confidence in the users of the system.

CLAIMS

1. A rescue system characterised by a personal transmitter (1) adapted to be attached, or worn, by a person and designed to be actuated in an emergency to emit a predetermined signal, an antenna (2A, 3) for receiving said signal, and a receiver (2) adapted to receive the signal from the antenna and to activate an alarm in response to said signal, said receiver including a detector circuit (2B to 2K) which responds to any variations in signal strength from the antenna for producing an audible (2Q) or visual (2O) indication of said strength, the arrangement being such that when the receiver alarm is activated by said signal, the rescuer can assess the direction of the signal transmission by variations of intensity of signal strength derived from said detector circuit of the receiver.

2. A rescue system according to Claim 1, for sea application, characterised in that for each personal transmitter (1) is provided with a battery which is activated directly, or via a switch, by contact with salt water so that the system can be operated with no action required from the man-overboard.

3. A rescue system according to Claim 1, for sea and fresh water applications, characterised in that a switch is provided having means for operation when it comes into contact with either salt or fresh water.

4. A rescue system according to any one of Claims 1 to 3, characterised in that two antennae (9,10) are provided for fixing to the masthead so that they are spaced apart to port and starboard, in that any signal transmitted thereto

is amplified by the receiver (2) to activate a boat alarm and thereby enable the helmsman to initiate man-overboard procedures, and in that, for locating the direction of the signal, said two fixed antennae (9, 10) are phased to provide left/right signal information for said receiver (2), which latter includes a display of the appropriate signal strength.

5. A rescue system according to any one of Claim 1 to 3, for a masted vessel, characterised in that one fixed omni-directional antenna (2A) is provided for fixing to the masthead to pick up an initial signal from a personal transmitter (1) and operate a boat alarm, and in that, for locating the direction of the signal, a second, portable, directional antenna (3) is provided which is connected to said receiver (2) and, in use, is handheld and swept around the vessel to obtain a reading (6) of greatest signal strength.

6. A rescue system according to Claim 1 characterised in that said directional antenna (3) is in the form of a plate (4), (eg of plastics) with sensing elements embedded therein in a directional array (eg a YAGI or logperiodic antenna), in that said plate incorporates a display (6), (eg a bargraph comprising a line of light emitting diodes (l.e.d's)) for providing a visual indication of signal strength, and in that an optional audible alarm may be provided with a tone which varies with signal strength.

7. A rescue system according to Claim 6 characterised in that said handle (5) provides a pistol grip to facilitate sweeping movement of the plate in a horizontal attitude, in

use, and in that said plate is stowed in a conveniently positioned holster (7) when not in use.

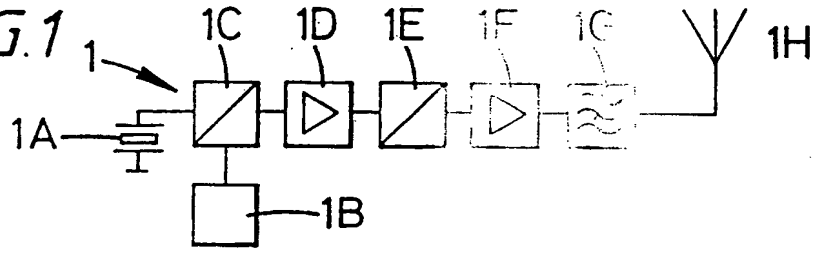
8. A rescue system according to any one of the preceding Claims, for marine applications, characterised in that a number of personal transmitters (1) are provided and are all on the same frequency, whereby a man-overboard can be alarmed, and located from any boat in the vicinity.

9. A rescue system according to Claim 8, characterised in that each personal transmitter (1) is designed to emit a coded signal, each vessel having a seperate code identity, eg one code for windsurfers or dinghies, another code for cruising yachtsmen, another code for racing yachtsman, etc.

10. A rescue system according to any one of the preceding Claims, characterised in that to smooth out sharp variations in signal strength during sweeping (eg due to wave movement between a vessel and a man overboard) said receiver (2) incorporates a memory circuit which is operative to ignore said sharp variations.

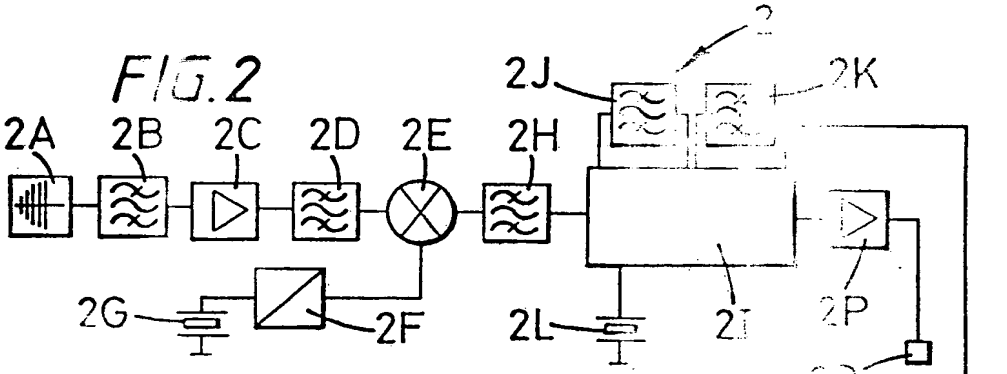
11. A rescue system according to any one of the preceding Claims characterised in that each personal transmitter has a manual switch to provide a test function to assure the user, said test function providing a short transmission to which the receiver will not normally respond to avoid causing nuisance alarms to other users in other locations within range.

FIG.1



1A = CRYSTAL
1B = MODULATOR
1C = MULTIPLIER
1D = BUFFER
1E = MULTIPLIER
1F = POWER STAGE
1G = LOW PASS FILTER
1H = ANTENNA

FIG.2



2A = DIRECTIONAL ANTENNA
2B = FILTER (BANDPASS)
2C = RF AMPLIFIER
2D = FILTER (BANDPASS)
2E = BALANCED MIXER
2F = MULTIPLIER
2G = CRYSTAL
2H = CRYSTAL FILTER
2I = SINGLE CHIP RECEIVER
2J = CERAMIC FILTER
2K = CERAMIC FILTER
2L = OFFSET CRYSTAL
2M = RECTIFIER
2N = LOGRITHMIC AMPLIFIER
2O = DISPLAY
2P = AUDIO BUFFER
2Q = OUTPUT TO SPEAKER / PHONE

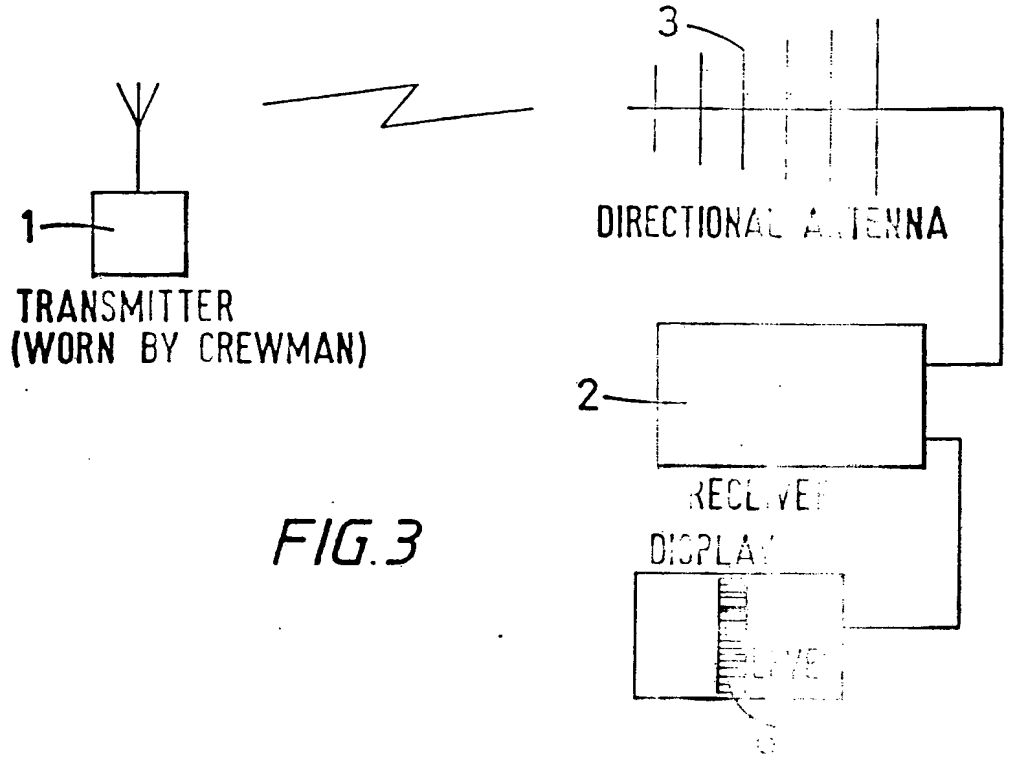

3
1
TRANSMITTER
(WORN BY CREWMAN)
DIRECTIONAL ANTENNA
2
RECEIVER
DISPLAY

FIG.3

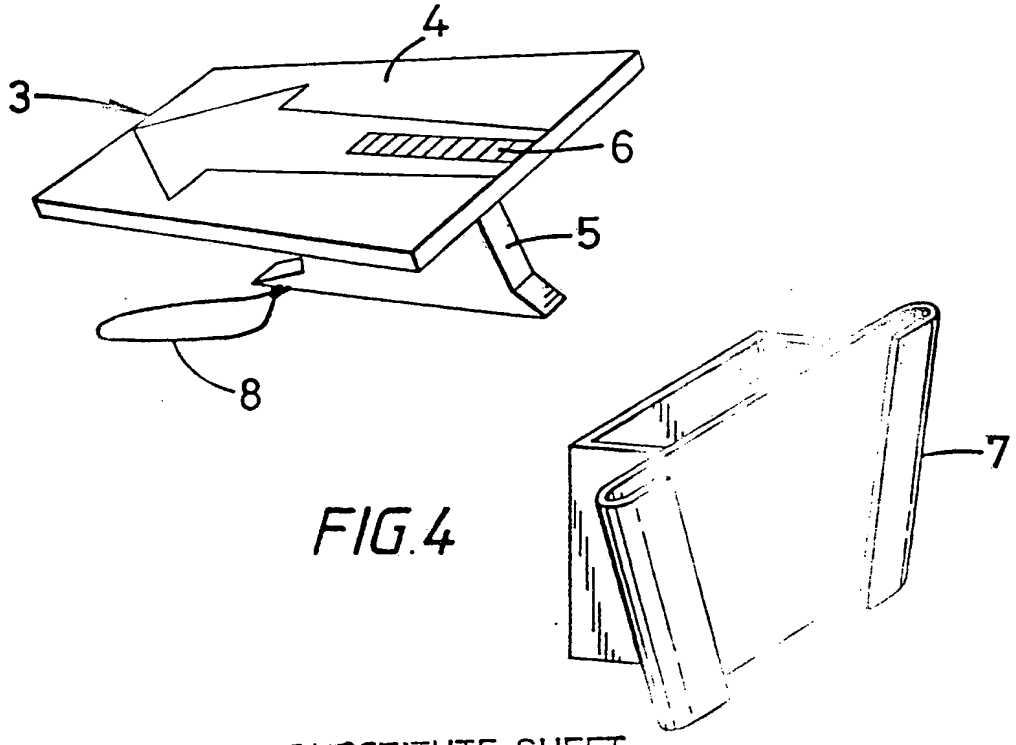
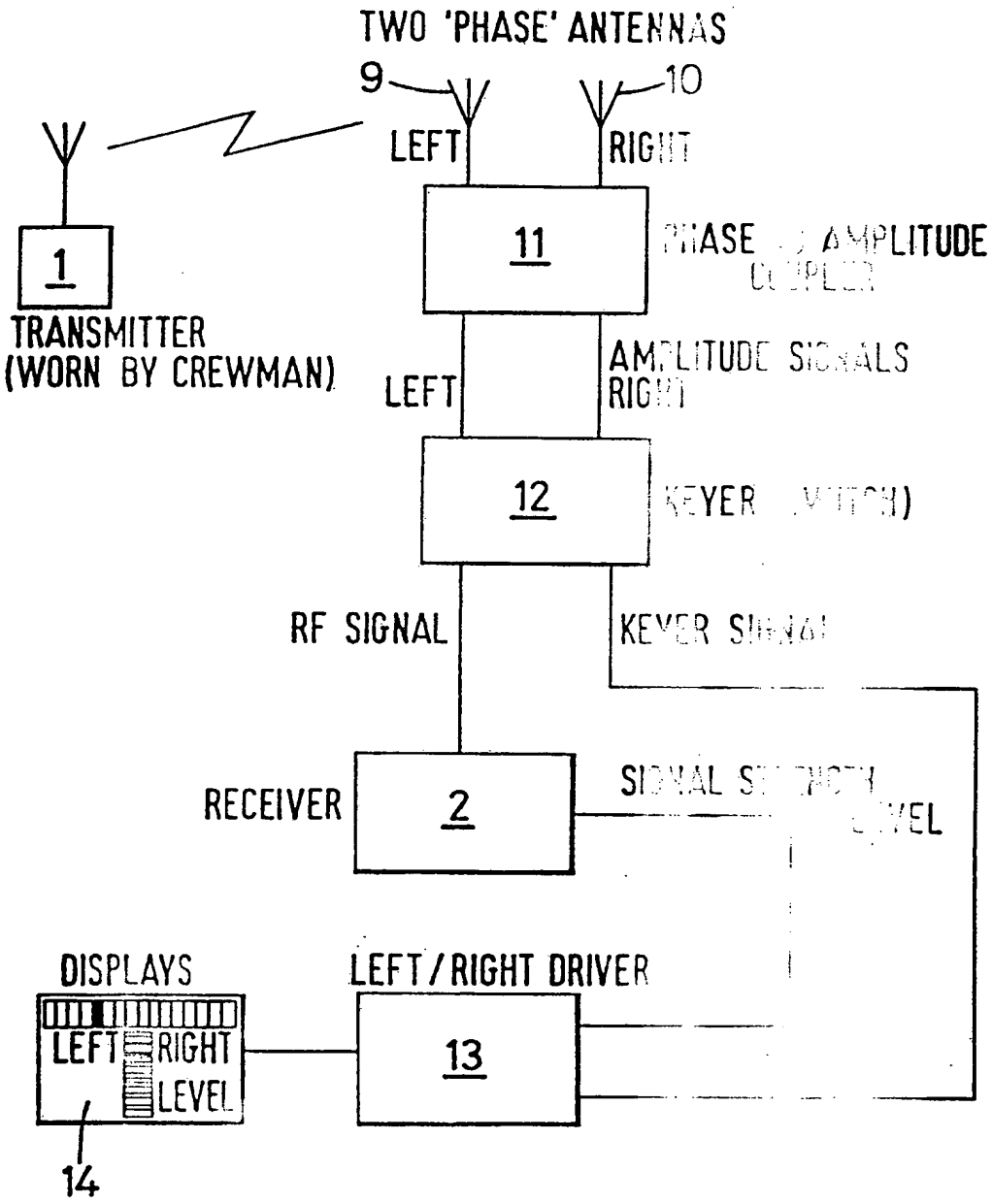

4
3
6
5
8
7

FIG.4

FIG.5


TWO 'PHASE' ANTENNAS
9
10
LEFT
RIGHT
1
TRANSMITTER
(WORN BY CREWMAN)
11
PHASE & AMPLITUDE
COUPLER
LEFT
AMPLITUDE SIGNALS
RIGHT
12
KEYER (SWITCH)
RF SIGNAL
KEYER SIGNAL
RECEIVER
2
SIGNAL STRENGTH
LEVEL
DISPLAYS
LEFT/RIGHT DRIVER
LEFT
RIGHT
LEVEL
13
14

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/00077

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC^5: B 63 C 9/00, G 01 S 1/68, G 01 S 3/40, G 01 S 3/16

II FIELDS SEARCHED

Minimum Documentation Searched

Classification System	Classification Symbols
IPC^5	B 63 B, G 01 S, G 08 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched

III. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	EP, A, 0230173 (ROYOUX) 29 July 1987 see the whole document	1
Y		2-4
	--	
Y	US, A, 4714914 (BOE) 22 December 1987 see abstract; column 6, line 47 - column 7, line 10; figures 1,7	2,3
A		11
	--	
Y	GB, A, 1527604 (COOPER) 4 October 1978 see claim 1; figure 1	4
A		1
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* Special categories of cited documents: 10
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
2nd April 1990	04 MAY 1990
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	M. KUIPER

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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SHEET)

Category *	Citation of Document with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	WO, A, 83/03904 (LICENTIA PATENT-VERWALTUNG) 10 November 1983 see abstract; page 5, line 6 - page 8, line 2; figures 1-5	4-7
A	US, A, 3683384 (WARREN) 8 August 1972 see abstract; column 2, line [illegible] column 3, line 25; figure 1,	7-9
A	DE, A, 3600802 (REENTS) 16 July 1987 see the whole document	1-6,8,9
A	GB, A, 2047039 (BROOKS NAUTICAL DEVELOPMENTS) 19 November 1980 see the whole document	4-6,10
A	DE, A, 1910173 (ESPRESTER) 24 May 1984 see column 2, lines 6-39; figure	6
A	FR, A, 2447318 (JAQUEN) 22 August 1980 see the whole document	1-4
A	US, A, 4633257 (APOSTOLOS et al.) 30 December 1986 see the whole document	4

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9000077 SA 33904

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 25/04/90 The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US-A- 4714914	22-12-87	None	
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		DE-A- 3330147	08-03-84
		DE-A- 3310029	06-01-84
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FR-A- 2447318	22-08-80	None	
US-A- 4633257	30-12-86	None	

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